

# Taxiway N Five Years Later

By Ronnie Goree, Asphalt Institute District Engineer

## Rehabilitating Memphis International Airport's Taxiway N



Above: FedEx Cargo planes lined up near Taxiway N at Memphis Intl. Airport

Right: Matt Carden, APAC; John Smith, Memphis Intl. Airport; and Ronnie Goree, Asphalt Institute, measure near zero pavement deformation at Memphis International Airport



In the summer of 1995 Taxiway N at Memphis International Airport was in need of immediate rehabilitation. But it couldn't be out of service long or it would cause chaos at the world's largest cargo airport—world headquarters for Federal Express and major passenger hub for Northwest/KLM Royal Dutch Airlines.

Standard rehabilitation with concrete would take approximately six months. Airport officials wanted something quicker.

They asked PDR Engineering Inc., to look at the 20-year-old concrete taxiway and determine the best and quickest way to rehabilitate it. PDR looked at six paving alternatives to rehabilitate Taxiway N's 14-to-16-inch concrete pavement. The alternatives included total replacement with concrete, total replacement with asphalt, an unbonded concrete overlay, a partially-bonded concrete overlay, and cracking and seating with asphalt overlay.

Taxiway N required a design that would accommodate 50,000 annual departures of the MD-11, a plane that weighs approximately 650,000 lbs. at takeoff. Rehabilitation had to last at least seven years, until a new taxiway could be constructed.

### Best Option

PDR concluded that a partially-bonded concrete overlay would not last because of alkali silica reactivity (ASR) in the concrete. ASR is a chemical process where the alkali in the cement reacts with silica in the aggregate in the presence of moisture. This process forms an expansive gel, breaks the cement paste between the aggregates, and damages the concrete. Cracking and seating or fractured-slab mechanics reduces ASR and rubblization eliminates it.

PDR also knew that simply overlaying the taxiway with asphalt would allow a reflective cracking problem to develop. Cracking the concrete would allow the pavement to breathe and still permit ASR to occur without damaging the concrete. After careful evaluation of the alternatives, PDR concluded





**Matt Carden, APAC Tennessee, and Ronnie Goree, Asphalt Institute, try to find rutting on Taxiway N at Memphis Intl. Airport**

that crack and seat technology with asphalt overlay was the best option for rehabilitation.

*The theory of cracking and seating is this: fracturing the slab turns the rigid concrete pavement into a flexible one. The purpose is to create a compatible modulus—one that is equal to the asphalt overlay. The higher the modulus, the stiffer the material. An ideal modulus for compatibility of the cracked concrete and the asphalt overlay is between 500 and 700 ksi.*

## Cracking and Seating

To make the concrete and asphalt compatible, PDR's design called for cracking and seating, thus converting the flexible pavement into a flexible base with a modulus similar to asphalt. To assure quality throughout the cracking and seating operation, PDR tested the pavement before cracking, during cracking and after cracking.

Following the cracking procedure, the contractor rolled the cracked concrete with a 50-ton roller. As it was rolled, the contractor adjusted the number of roller passes to create the proper modulus.

## Mix Design

The mix design was done in accordance with Federal Aviation Administration (FAA) P401 specifications. PDR made the mix slightly stiffer, however, by making it on the coarse side of the specification band. This resulted in a mix with slightly higher stability to meet the heavy demands of Federal Express plane loads and the sharp turns necessary when the planes were preparing for takeoff.

To assure consistency of the mix, PDR put round-the-clock technicians in the field, directly supervised by PDR.

## Partnering

Partnering was an important part of the Taxiway N project, says Nick Haynes, Regional Vice President for APAC Tennessee, Inc. "The project wouldn't have been successful without our partnering agreement." Although a number of engineering firms told them the rehabilitation couldn't be done in a 30-day time period, both APAC and PDR believed that it could. "The project was unique," says Joe Polk, Manager of Construction Administration, Memphis-Shelby County Airport Authority/Memphis International Airport. "We couldn't have done that work in that short time using concrete."

## Paving

APAC was the paving contractor on Taxiway N. The project began on September 15 and was completed October 15, 1995. The design called for 5 inches of FAA P401 hot mix asphalt (HMA) on the cracked and seated taxiway. The mix was placed in two lifts containing 3/4-inch topsize rock.

## Five Years Later

Five years later, there is little or no rutting on Taxiway N. "Today, in the Summer 2000, the air traffic count and the weight distribution is higher than it was four years ago," says Matt Carden, APAC Regional Vice President for the Memphis area. "As far as rutting goes, I can't tell any difference from last year. It's about 1/8 to 1/4 inch in a few places, with an average of about a 1/8-inch. If it holds up in this heat—105°F—I think it will hold up for a long time to come."

Polk says "there are no significant signs of failure of the asphalt overlay on Taxiway N. We thought we would have some cracking out there, but there is none."

## The Team

PDR was the prime engineering consultant and construction manager on the Taxiway N project, and Roy McQueen Associates provided special pavement non-destructive testing and Quality Assurance.

APAC Tennessee, Inc. was the paving contractor and was also responsible for the cracking and seating operation. S & ME Laboratory of Arden, North Carolina, and Kimley-Horn supplied design assistance and construction administration assistance.

Memphis International Airport officials are pleased with the rehabilitation results on Taxiway N. "The timely and successful completion of the Taxiway N Rehabilitation project was of critical importance to the Memphis hub and its tenant airlines," said Memphis International Airport president Larry Cox at the completion of the project.

"The unusual demand to compress what would normally be a 4-to-6 month replacement project into a 30-day period required exceptional and unique attention and techniques. We are hopeful that this project could set a national precedent as another option for airfield pavement repair." ▲